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A contextual approach to design and development of interfaces for search engines, using Activity Theory as the basis for informing design decisions

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Abstract

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Keywords

Contextual, Approach, Design, Development, Interfaces, for, Search, Engines, using, Activity, Theory, basis, for, informing, design, decisions

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might have for further elaboration of Activity Theory are examined.

With each paper a different dimension of the applied use of Activity Theory is adopted and the study of socio-technical tools is undertaken. The widely varied contexts of the above studies indicates the growing application of AT to emerging digital world The increase need for interacting activity systems is clear as is the need to further develop our understandings of work-based activity systems.

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Abstract

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Introduction

The research presented in this chapter investigates the design of search engines in the context of information seeking activities. This study is informed by Activity Theory and considers Information Seeking to be a Keystone Activity. (Meloche 2004). In examining an information seeking activity in context, Information Technology is viewed as the "tool" and information as the "goal" or "object" of the search process. Information seeking is therefore the active process or "activity". The contextual nature of this activity points to the importance of the environment in which this activity occurs.

The goal of this study is to support the design of more effective search engines. This improvement in search engine design will take into consideration the context of users, and thus needs to elicit and capture users' explicit and implied requirements. The study uses Q-methodology to collect, sort and analyse detailed statements as seen through the personal lenses' of the participants of this study. Among the several possible approaches and methodologies that could be used for this study, Activity Theory and Q Methodology were selected for their ability to gain insights from the users perspectives (Q Methodology) and isolate and relate the key components of activity in a meaningful way (Activity Theory).

Background

Information seeking is an essential activity of most people's lives, through which they can deepen and/or broaden their knowledge and have an understanding of their world (Meloche 2004). Information seeking in this view involves more than a physical action, i.e. collecting information that addresses the users' needs. Information searching and retrieval forms an essential part of, and are core actions in, information seeking. This view builds upon earlier views that saw that the goal of information seeking is to guide the user from the uncertain or unknown state to a more certain and/or known state, (MacMullin and Taylor,1984). Thus searching for information is one of the first steps and one of the most important procedures during this process of reducing uncertainty. Information seeking, accordingly, is the user's sense-making process, and consists of three realms of activity: *physical*, actual actions taken; *affective*, feelings experienced;

and *cognitive*, thoughts concerning both process and content. (Kuhlthau, 1993)

The user's actions result not only from their experience about seeking information but also from other related experiences, including, learning, communication and education, all of which have a critical impact on their current information seeking activity. The cognitive structure of people is complex, and cognitive structures can be understood to be interweaved within the knowledge states of the individual, (Ingwersen 1992). Areas for investigation have included cognitive models, work space analysis, actual state of knowledge, problem spaces, and states of uncertainty (ibid).

With the development of information and communication technology, notably the Internet, there is access to an enormous amount of stored information, sourced from databases via the World Wide Web.

There are basically three main ways to locate information on the World WideWeb. The first one is serendipitous discovery, as most Web Pages contain links to other pages. Thus if users know the URL of one page to start with, it is possible to go to (almost) anywhere on Internet. (Maze, Moxley & Smith, 1997) However, in most cases this approach is time consuming and difficult to reproduce later, as once too many links are followed, the original topic will be lost. The second approach is a provided by Subject guides, Subject guides provided by established websites, such as Yahoo, allow the user to locate information using a hierarchical subject tree. Here, indexers assist the users to locate information quickly, by the classification of the information, but with this method the users are at the mercy of the indexers' sense of what information belongs where.

The last option is to retrieve information using a search engine (Maze et al, 1997). Search engines typically allow users to input keywords, and to collect and list information according to their demands. This approach allows the subjectivity of users to have a role in information seeking. There are various types of search engines, and they can be divided into to two broad categories. One is specialized search engines, and the other is the general-purpose searches, which can further be divided into two sub-categories: direct and indirect, depending on whether or not search engines have their own database of web pages and

indexes (Li et al, 2001). While there are still lots of problems in their design, search engines, are one of the most important tools for information seeking online, and are an area that requires further investigation if information seeking is to improve. The focus of this chapter is on context based design considerations, for search engines.

While the search engine is now an essential tool for web-based information seeking, in many cases using a searching engine is only the first step in a more meaningful activity. Actions, such as searching for information, whether for an assignment, or for report writing, or for more general activities such as online shopping, are usually only part of a larger information seeking process.

These seemingly simple acts are usually part of a larger purpose that may, for example, include obtaining a degree or conducting daily professional work. While search engines are frequently used, they are still not explicitly designed for these larger purposes. Search engines need to not only be a tool which assists searchers to locate the immediate information needed but can also support seekers to successfully achieve larger aims associated with their information seeking activity.

Thus the interfaces for the search engines need to be improved to better support this potential use and they need to be studied within their context of use. As search engines are frequently used in conjunction with web-based services there is also a need for greater integration into these services and for their design to take fuller advantage of this potential.

For this development to occur, research methods should be used that more fully account for the nature of the activity associated with the use of search engines in the web environment. The objective of this study is to support the future design of search engines in the context of E-commerce. Thus this research uses an Activity Theory Framework to capture and assess the context of users and Q Methodology to account for the subjectivity of users. It is almost certain that using the Internet via the World Wide Web is becoming the first choice for most people in information seeking, and as such, is an important domain for this research.

Activity Theory

Activity theory is an interdisciplinary approach to human sciences that originated in the former Soviet Union as part of the cultural-historical school of psychology founded by Vygotsky, Leontjev and Lurija. (Rodriguez, 1998) This new orientation was a model of artifact-mediated and object-oriented action (Vygotsky, 1978, p. 40). This theory is used here as a framework for studying searchers' needs and for developing effective search engines. According Bonnie Nardi to Activity theory is a powerful and clarifying descriptive tool rather than a strongly predictive theory. (Ryder, 2004)

With Activity Theory, activities, including keystone activities such as information seeking, can be decomposed, into their core components. Activity systems are comprised of tools, community, subjects and their object, where the tools and the community mediate the relationship between subject and object. Activities can also be seen as comprised of actions and actions are comprised of operations. Each of them, whether activity, action, or operation, are categorised in accordance with their purpose. Thus to develop more effective design requires alignment with social and cultural aspects in the context of use.

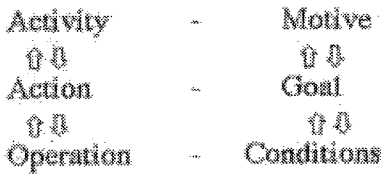

Figure 1 The Activity Theory Hierarchy (Leontiev 1981)

Activities are associated with motives and purpose where people are motivated to accomplish an objective. In other words "an activity ... is the term is used to describe a motivated set of actions intended to achieve a result." (Hyland, 1998). Unlike an activity, an action has a more clearly defined goal. Thus activities can be decomposed into actions, and the goals of actions work towards the motive or objective of an activity. The relationship between operations and actions is similar to those of actions and activity. However, the context of an activity influences the motive

of activity and level of categorization. For instance, information retrieval may operate at each of these levels as an activity, action or operation for an experienced searcher, but would be an activity, for a novice while learning to use the technology. Therefore, cultural and historical contexts are important considerations in this study and activity theory accounts for the various elements that need to be addressed.

Here, Activity Theory is used not just for categorisation; it is selected to acknowledge the context of users for the design enhancement of search engines. Failure to adequately profile users is one of the problems that causes ineffectiveness in current search engine designs. Activity Theory can be used to investigate the use of search engines with consideration of the context of the users. The users selected for this study are either from the business community or academics or advanced students studying in a business degree.

Q Methodology

Q Methodology is one of the more effective methods for studying issues and the essential distinctions between them. The factor analysis provided by Q Methodology is typically based on the statements of participators, and choices made between these statements, and thus it takes the subjectivity of the individual participants into consideration. The factors generated from Q Methodology, reflect the issues the population places importance on, in the domain of researchers' interest, so in this way the research can assist to resolve these issues and offer some practical results. Other methods are less open to the views or the population.

The purpose of using Q Methodology in this study is to elicit the subjectivity of users' views into the design of search engine, not just to follow the principles of designers and researchers. The collection of the statements in this case arose from the literature of online searching and was selected by the researcher to reflect the range of views currently being discussed on search engine attributes and design.

Implementation of Q Methodology

As mentioned in the former section, Q Methodology is selected and used to elicit users' subjective views. In order to easily elicit

the opinions with subjectivity, it is important to define the domain with caution (Robbins, 2005). This step decides the characteristics of Q study. In the survey methodologies, the number of samples is very important, because the average is the basis of further analysis. In Q Methodology, this number is not as important. There are several approaches that can be used to assemble the subjective statements of a population, such as personal interviews, interviews though telephone, or statements expressed by people in published papers, or on TV, radio, etc. Then using these statements, Q-sorts are developed. Most Q-sorts are quasi normal distributions, with the items placed at the extremes being the most significant for further analysis. After this phase, sometimes adjustments (factor rotation) can be done based on experience and judgement in order to make further analysis. When this is done the coordinates are rotated, but the correlations among factors are not changed. In this study, we used a Varimax rotation and the resulting factors are further analysed using Activity Theory.

The Statement List

The domain of this investigation focuses on the users' views of search engines in the context of E-commerce. Current search engines have been redesigned and adapted many times. The subjective comments (statements) used in this study have been assembled through a variety of media, with most statements obtained from the academic literature. The set of [53] statements collected is listed Appendix A.

The Q-sort

In order to elicit the subjectivity of users with respect to the statements, Appendix A, a Q-sort was arranged with 15 participators (sorters), who took part in this study. All of the participants are students currently studying DBA with the University of Wollongong. They were given some brief introduction and instructions about Q sorting first, and then provided with the set of 53 statements and then a paper sheet with the scoring scale was distributed to them.

In this Q-sort, the sorters were required to allocate the items in accordance with the following scale paper (with 9 piles and 5 centroids).

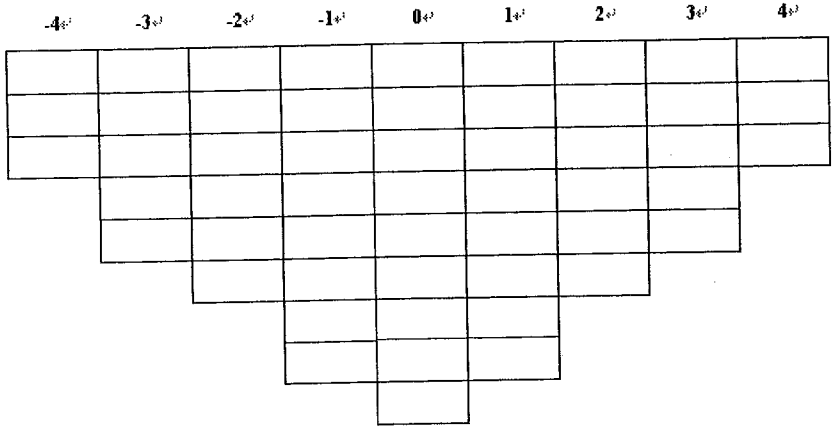

Figure 2 The Q-Sort Grid for 53 Statements

In the Q-sort grid shown in Figure 2, the items placed in the middle are viewed as being less significant. That is the sorters placed less emphasis on the items with label "0". The items with a label "4" indicate that the sorters agreed with these items strongly. Likewise, the sorters placed the most disagreeable items under the labels "-4". All of the others items are placed between most agreeable, label "4", and most disagreeable label "-4". The items at the extremes are most salient or significant (Robbins, 2005), and need to be analysed carefully and comprehensively.

Each statement was printed on a small paper (card), and the statements were numbered on the opposite face of the card to assist with recording the results. Each sorter ranked the 53 items based on their perspectives, and the items were arranged in accordance with the instructions. When the sorting was completed each sorter turned over all of cards and recorded the number of item onto the scoring scale paper. The grid papers were collected and the numbers on them were processed using the PQMethod program.

Analysis of the Factor Solutions

The number of factors used to analyse the results from the Q study was decided as follows. Using the PQMethod program the results from the Q study were briefly analysed in four solutions,

3 factors, 4 factors, 5 factors and 6 factors. Four parameters of each solution were examined, (variance, number of sorts, number of confounded sorts and number of insignificant sorts) and compared.

The following chart provides a quick comparison of 4 different factor solutions.

No. of factors	Variance (%)	No. of confounded	No. of insignificant	No. of sorts	Note
3	30	4	1	10	
4	35	2	2	11	Only one sort in Factor C
5	39	2	2	12	
6	42	2	0	13	Only one sort in Factor D

The following criteria, was used to select the final factor solution:

1 Degree of variance (%) accounted for
2 Number of confounded sorts and insignificant sorts
3 Analysis of the "type" of sort/individual on the factor
4 Number of sorts accounted for in the solution

According to these criteria, a 5-factor solution was selected for the result as

1 There are no consensus items in the Q-study with 5 factors.
2 No items distinguish any factor in the Q-study with 5 factors.

Factor correlations (varimax)

Factors	A	B	C	D	E
A	0	20	-23	24	-30
B	20	0	-21	1	-17
C	-23	-21	0	-6	0
D	24	1	-6	0	-14
E	-30	-17	0	-14	0

According to the statistical analysis, there are no items that all of the five factors either strongly agree or disagree with. The factor correlation table shows the relationships between the factors. The weaker the correlation, the more distinct is that factor in comparison with the others.

Results of the Q-sort

The classification and significance of the 15 sorts on the factors are listed as follows. The 12 sorts which are statistically significant (exemplars) have been accounted for in the selected 5 factors.

No. of sorts	Factor	Sorts Contributing to Factor	Gender
3	A	1, 9, 13	M
3	B	2, 4, 6	M
2	C	10, 11	M
2	D	3, 8	M
2	E	5, 15	1M, 1F

Two sorts were confounded: 7 and 12. Sort 7, while confounded in a statistical sense, was not actually confounded as it is positively significant on Factor A and negatively significant, on Factor B. For it to be truly confounded it would need to be either in agreement or disagreement on more than one factor. This type of result clearly indicates the strength of his views in relation to the statements, while "technically" confounded. He will be considered to be significant on Factor A. The other confounded sort, sort 12, was also of interest in Factor A, in the same was as sort 7. In fact the sort was even higher on Factor A than sort 7, and unlike sort 7, was also significantly high on Factor B. These two sorts, sort 2 and 7 will be analysed further.

Sort 14, while not statistically significant on any factor, still differentiated between the factors, given that it had a nearly significant weighting on Factor E. So it is considered to be "on" Factor E as well.

Analysis of Results by Activity Theory

In Activity Theory the relationship between human agent and objects of the environment is mediated by cultural means, tools

and signs. Figure 3 is the triangle developed by Engestrom (1987), which graphically displays the relationships between the various elements. In the interpretation of the results of this study, the characteristics of the five factors from the Q-sort are analysed in the context of the Engestrom Framework using the following correlations: Objects (the desired information) Tools (search engines in the context of E-commerce) Subjects (individual participants). Each Factor that emerged from the Q-sort has been given a suitable label by the researchers as a result of the analysis and interpretation.

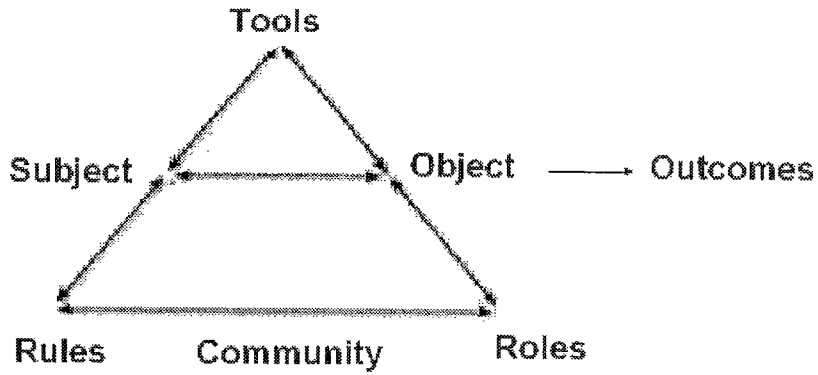

Figure 3. The structure of an activity (Engestrom 1987).

Analysis of Factor A: *The Searcher*

After analysing the 10 highest ranked positive statements and the 10 highest ranked negative statements from the sorts supporting Factor A and noting what the participants strongly agreed with and disagreed with respectively, it is clear that the sorts significant on Factor A, pay more attention to the **layout of results** and the **ranking criteria** in search engines. The various functionalities provided by search engines and E-commerce websites do not greatly attract them.

The first statement listed in the 10highest ranked positive statements of Factor A is "*no annoying pop-up ads*". Most sorts on Factor A support this statement. Moreover, these sorts desire

that "*visitors feel security and trust*", "*the results list is the most prominent thing on the page*", and "*the search feature is easily visible*". These choices indicate that sorts on Factor A would like the layout of search engines, especially the searching results, to be clear and concise.

The attention of the sorts supporting Factor A also focus on how the results will be ranked. They would like to "*prioritize the results*", "*rank results in an unbiased transparent fashion*" or "*according to their demands*", and have some recommendations and help from the search engines in order to review the results needed more easily and quickly. In their opinion, the purpose and functions of search engines is to help them collect information and to meet their information needs, even in the context of E-commerce.

Therefore, they pay less attention to the various functions provided by search engines and E-commerce websites. This is clearly demonstrated by the 10 highest ranked negative statements for Factor A. For example, they strongly disagree with the use of "*online forums*", "*breadcrumb navigation*", "*personalized E-commerce Web pages*", and "*one-to-one marketing programs*". E-commerce websites provide these additional functions to users in order to help users with shopping online after collecting useful information. However, the sorts on Factor A do not like these additional functions. It would seem that they just use the E-commerce website to search for information, and they still like to do their shopping conventionally, face-to-face.

Summary:
Sorts on Factor A pay attention to the **search functions** of E-commerce websites, particularly **the layout of search engines** and the **prioritized ranking criteria**. It is possible that they are searchers of E-commerce websites, but are not online shoppers, so obviously they do not desire the additional functions provided by search engines and E-commerce websites.

Analysis of Factor B: *The Efficiency Expert*

Similar to the sorts supporting Factor A, the sorts on Factor B strongly agree with statements 50, 16 and 21. However, after analysing other statements in their 10 highest ranked list, it seems that their focal point is different from that of the sorts on Factor A. They would like to "*present results lists clearly and simply*", "*highlight search terms*", "*provide comprehensive search results*" and "*allow refined searches within the results of the initial search*". What is most informative is their agreement with statement 26, "*avoid all lost pages, blind links, ancient products that don't exist anymore, orphaned links etc.*", which is the statement that the sorts on Factor A disagreed with most strongly. Thus, the sorts on Factor B **focus on the efficiency**, and appreciate the systems, screening ineffective material for them. They would like to have search engines **efficiently collecting useful information** and meeting with their needs and demands **quickly**. Actually, the focal point of these sorts is on **speed**.

On the other hand, the 10 highest ranked negative statements, for Factor B, make it clear, that they pay less attention to the layout of search engines and the various additional functions provided by E-commerce websites and search engines. Their view on additional functions is almost the same as that of the sorts on Factor A, because both of them disagree with statements 30, 5, 24. Other statements in their highest negative ranked list, include "*results should be clearly formatted*" and "*make the results list the most prominent thing on the page*". This shows that they pay less attention to how search engines and search results are laid out.

Summary:
The sorts on Factor B regard time as valuable and pay less attention to the layout or "friendliness" of search engines. They would like to achieve their tasks, information searching, **quickly and efficiently** with the help of search engines. Similar to the sorts on Factor A, they do not appreciate additional functions of E-commerce websites and search engines. Perhaps they are not online shoppers either, but experienced online searchers who have no time to waste.

Analysis of Factor C: *The Functionalist*

Like the sorts on Factor A and B, the sorts supporting Factor C chose statement 21, "*no annoying pop-up ads*". However, other statements in the positive 10 statements of Factor C are contrary to those of the former two factors. By analysis, the sorts on Factor C like the various additional functions provided by search engines and E-commerce websites, which make their tasks, such

as searching for information and shopping online, easier. They like to "*have direct access to the suppliers' website and facility to make an order*", "*have breadcrumb navigation*", "*classify and specify product lines in the results*", etc. Therefore, their focal point on search engines is, ease of use. Thus, it seems that they are unfamiliar with using online search engines and the Internet, and they would like to achieve their tasks by simple operations, such as clicking buttons or links.

According to the former analysis, they are the functionalists of online search engines and they put their emphasis on ease-of-use. Therefore, they pay less attention to the ranking criteria, time spent on collecting information, and other issues that other sorts have focused on. In this Q study, they disagree with most of the statements about ranking criteria. The reason is that they seem to care about the ease of use functions provided by online search engines and they pay less attention to the internal processes of search engines. They just focus on the **ease of use**, and seem to have enough time for information searching. Thus, they ignore whether there is "*the information in the results*" or it is "... *up-to-date* ...", which is the highest ranked negative statement for the sorts on Factor C. They apparently have adequate time to check the validity of the information, which they collect from online search engines.

Summary:
The sorts on Factor C are regarded as the functionalists of online search engine users. They focus on ease-of-use. They like various functions provided by search engines and E-commerce websites that can help them surf and shop online easily. Additionally, they pay less attention to the internal processes of search engines, such as, ranking criteria and the quality of information provided by search engines, because they know less about how search engines work and they have adequate time and energy to be spent on searching.

Analysis of Factor D: *The Shopper*

Comparing the agreements and disagreements of the sorts on Factor D with those of other sorts, it is almost certain that the sorts on Factors D represent the online shopper.

The 10 highest ranked positive list of statements makes it clear that the sorts on Factors D like functions, including the

ability "*to provide simple step-by-step instructions to locate products and make purchases*", and "*to provide direct access the suppliers websites and facility to make an order*", most of which can support them to shop online and simplify the operations of online shopping. The most significant evidence is that they strongly agree with statement 17, "*Prices and features of products can be compared according to searchers specifications*". As online shoppers, they can collect considerable information about products meeting with their requirements, and there are needs for them to compare the features, especially the price of products before making decisions and purchasing online. Furthermore, they also agree with statement 35, "*allow pausing so shoppers can return to continue shopping later*", which indicates that they are actual online shoppers.

The focal point of the sorts on Factor D in the highest ranked negative statements is not very clear, but most of statements in the list support the opinion that they are online shoppers. For example, they do not like statement 4, "*when the search term is too generic, it should suggest alternatives*". As online shoppers, sometimes they would not like to have to define their needs in more detail. When they would like to buy a camera to take photos, they would just input "camera" as term. This kind of generic search term give them more options, such as film camera or digital camera, SONY or NIKON, and they have more power and authority to compare products and make the final decision.

Summary:
Considering the 10 positive and 10 negative statements of the sorts on Factor D, the evidenceis that they would like to shop online. They like the functions provided by search engines and E-commerce websites to support them to shop online and demand authority to make final decisions about operations including information searching and online shopping.

Analysis of Factor E: *The Negotiator*

The sorts on Factor E strongly agree with statement 19, "*display the shipping and sales tax rates*", which makes the sorts on this factor different from the other factors. Statement 19 is not present in any of the 10 highest ranked positive lists or the 10 highest ranked negative lists of the other factors. However, it is the first statement in the 10 highest ranked positive statements

of Factor E, which indicates that the sorts on Factor E think of tax rates and money. Furthermore, they like to "*rank result based on webpage popularity*" and "*allow pausing during shopping*". Possibly, in their opinion a desirable webpage equals a webpage that provides the cheapest products, and before they pay money they would like to be able to stop, think about and review their decisions. Therefore, they are careful negotiators. They use the efficiency and functions of search engines and E-commerce websites to collect information of cheap products.

The most interesting situation in the 10 highest ranked negative statements of Factor E is that the sorts on Factor E disagree with statement 21, "*no annoying pop-up ads*", which the sorts on Factor A and B rank highly. The sorts on Factor E actually prefer pop-up advertisements. One explanation for this choice is that they would like to read ads and collect some promotion information in order to be able to select the best value in a timely manner.

Summary:

Though the focal point of the 10 highest ranked negative statements for Factor E is not very clear, most of these negative statements, particularly statement 21, are characteristics of negotiators. Moreover, taking into consideration most of their highest ranked statements, they attach considerable importance to expense. They are negotiators and like search engines and E-commerce websites, which can provide them with help and functions that support information collection about cost competitive products.

Discussion in the Context of an Activity Theory Framework

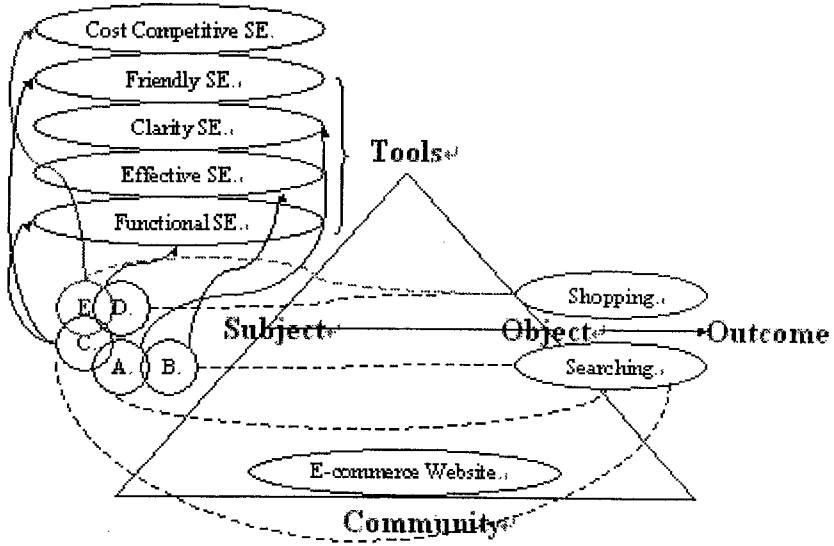

Figure 4. An Activity Based Framework relevant to Search Engines.

After the analysis of the distinctive characteristics of each Factor (the subjects, with similar and dissimilar views), it is clear that while they have related objects on results and presentation of search engines, these belong to different categories. There is an obvious gap between the object and the outcomes of activities involving search engines. Using search engines in the context of E-commerce and online shopping will take up a significant proportion of time in the future. There are needs to study the design of effective search engines and the framework of Activity Theory provides a useful approach.

From the Activity Theory perspective, Subject, Tool, and Object (leading to Outcomes) have a dynamic effect on each other. The Tool (search engines) can be redesigned according to the background of the Subject and his/her Object in order to minimise the gap between Object and Outcome and to improve the satisfaction of the searchers. The change in the tools however also changes the other components of the activity including

attributes of the subject.

According to the categories of the factors in this study, search engines in the context of E-commerce could be redesigned, taking the background of subjects and their object into consideration. All of the sorters in this study were part-time research students and have a strong academic background. However, from the factors it is clear that a deeper level of difference is present and that they have different experiences with the use of search engines in the context of E-commerce. Additionally, in the analysis of the factors, their objects can be divided into two broad classifications: searching and shopping.

Most of the sorters in this study are not shoppers. The motive of the first classification, **searching** (Factor A), is to collect useful information in order to meet their information needs. It is not clear why they would like to collect the information in E-commerce websites. It is probable that their purpose is related to their research or to support their conventional shopping. Searching for this group is of itself is not the activity. Thus searching for them is the "action" contained within the activity of shopping or study. Search engines as tools should assist them in reducing the gap between their objects' and the actual outcomes. It is clear that their objects are to meet with their information needs. According to their subjective statements in the Q-sort, the sorters are "on" Factors A and B based on their experiences on search engines. However their consensus is that they do not desire the extra functions provided by search engines in the context of E-commerce. Moreover, the **searchers** (on Factor A) pay attention to the layout of search engines and the **effiency experts** (on Factor B) focus on the efficiency of searching, and it seems that both like the clear and clarity presentation of search engines.

Online shoppers have different motive namely to do shopping online and E-commerce websites can take advantage of this. For **shoppers** (Factor D), using searching engines in the context of E-commerce is just an action, because the goal of searching is to support their activity. From the point-of-view of Activity Theory, the tools, **search engines** in the context of E-commerce, should reflect the object of their activity, shopping online. In this study, there are two sorters in this classification. One of them is a mature online shopper, and another is a novice. Although they

have different background and experience with shopping online, both strongly agree with Factor D. They differ from the searchers in that they desire additional functions to be provided by search engines and E-commerce websites. As the person who pays money for products or services online, they would like to have absolute authority over their actions. It seems that they would like to have search engines and E-commerce websites with easy explicit operations that encapsulate complex processes, reflecting their decisions.

The sorts in the last classification have less clear motives or goals. In this situation, the design of search engines should elicit their motives. Based on the framework of Activity Theory, tools and objects mutually impact each other. In their case the design of search engines should be flexible and be able to adapt to the objects of subjects. In the context of E-commerce, the managers and designers of search engines would like to persuade their users to participate in shopping online. Thus it is important for search engines to encapsulate the complex processes associated with this activity. They can provide seemingly simple operations, and highlight the difference between online shopping and conventional shopping in order to attract the users of search engines to become online shoppers.

Conclusion

Recommendations

Based on the results of the Q Methodology analysis and the framework provided by Activity Theory, the subjectivities of the users of search engines in the context of E-commerce were elicited and analysed. The activity systems and their respective purposes are hierarchical, and there are mutual impacts among Tools, Subjects, and Objects. The motive of this study is to establish the effectiveness of using these methods to improve the effective design of search engines in the context of E-commerce and to improve the users' satisfaction. In other words, this study established that, by means of the analysis using Q Methodology and Activity Theory it is possible to make recommendations for the redesign of search engine in order to reduce the gap between the stated objects and outcomes of the participants.

From the analysis, it is clear that the designers of search

engines should adapt the presentation functionality of search engines according to the different classifications of users. The user's motive for searching has been shown to be a clear indicator of the search engine design requirements. The online shoppers, for example, desire absolute authority to make final decision of shopping, and thus search engines which incorporate ease-of-use and encapsulate the complex processes that address their needs. The users in the classification who surf online can also have a design of search engines that helps them elicit their motives and facilitate their potential development into the classification of online shoppers.

The effective design of search engines needs to take the background of subject and their, object, into consideration. Different users have different desires from search engines, and the designers of search engines should adopt their design accordingly in order to reduce the gap between users' object and the actual outcomes. This method provides a basis for effective design of search engines in the context of E-commerce. The use of Q Methodology allows for the subjective complexity to be examined in greater detail. Activity Theory allows for the complex relationships including social, cultural, setting and purpose to be studied.

Limitations

In this study all of the participators are doctoral students and most of them are male. Therefore their backgrounds are similar although their objectives may be different. According to the framework of Activity Theory, the role of users and their place in the community have significant impact on the object and the effective design of tools, such as search engines, which should be analysed and discussed in further study.

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Appendix A

1. Layout of search engine is clear, so that button or link demonstrates its meaning or function accurately.
2. The search function should appear as, a type-in field, in the navigation bar, preferably at the top right.
3. With a keyword search, it should automatically check spelling, and provide alternative spellings, or terms.
4. When the search term is too generic, it should suggest alternatives.
5. Incorporate "breadcrumb navigation" to show where the currently viewed web page is located in the site hierarchy with shortcuts to move up the hierarchy.
6. Maximize the screen real estate to minimize scrolling.
7. Provide simple step-by-step instructions to locate products and make purchases.
8. Allow the user to nominate the domain searched
9. Offer online forums, which include product recommendations and user-contributed reviews for each product page.
10. Rank results based on the content of the pages.
11. Provide search queries with context.
12. Rank results in an unbiased transparent fashion.
13. Limit the number of similar web pages in the search results.
14. Allow to the user to nominate the type of information being sought I.E graphic, text
15. Rank results based on webpage popularity, such as, the number of visitors and how long they stayed.
16. Results ranked on theme strength.
17. Prices and features of products can be compared according to searchers specifications.
18. Provide direct access the suppliers website and facility to make an order.
19. Display the shipping and sales tax rates.
20. Give visitors the feeling of security and trust.
21. No annoying pop-up ads.
22. Highlight search terms on the retrieved page.
23. Mark the web pages that have been browsed.
24. Ability to personalize e-commerce Web pages.
25. Provide up-to-date information in the results.
26. Avoid all lost pages, blind links, ancient products that don't exist anymore, orphaned links etc.
27. Keep a balance between the attractiveness of the interface and the ease of navigation.
28. Search engine is always present on the E-commerce website.

29. Provide information according to visitors' shopping experience and their personal information.
30. Provide one-to-one marketing programs, for Products, Price, Promotion, and Place.
31. Provide comprehensive search results
32. The searcher determines the level of detail in the results.
33. Provide information and suggestions.
34. Classify and specify product lines in the results.
35. Allow pausing so shoppers can return to continue shopping later
36. The search engine should be a dedicated "Shopping engine" that is easy to use and have related functionality.
37. Plural and singular keywords lead to same results.
38. Provide visual information,
39. Results should be clearly formatted
40. Provide one-click function to print out or save results.
41. Allow for refined searches within the results of the initial search
42. Rank the results according to the visitor's demands, such as price, relevance.
43. Provide "Help" or "Tips".
44. Support advanced searching with operators AND, OR & NOT
45. Search feature is easily visible, "right there", not lost in the clutter of other links, menus, content, ads, and decoration.
46. Search input box on the site's home page, rather than a link to a special "search screen".
47. Search box should have a consistent location on all pages including the home page.
48. Avoid extra fields or options such as "search for all words or any words" around the first search box.
49. Make the results list the most prominent thing on the page. The results should not be buried halfway down the page; displayed in small type or in weak colours
50. Prioritize the results, with the "best" matches first.
51. Present results lists clearly and simply.
52. Results lists should be annotated list of links, including a useful headline and a short description that actually described the content of the page.
53. Provide recommended links or "best bets" for frequently searched terms.